What is claimed is:

1. An active filter that can be connected to a power line between a power source and a load, the active filter comprising:

a current generator that can be connected to the power line, wherein in response to a control signal the current generator generates a current i_{APF} to compensate for polluting harmonics on the power line; and

a controller that generates a control signal that controls the current generator to compensate for the polluting harmonics on the power line, such that the current i_{APF} does not exceed a selected threshold value.

2. The active filter of claim 1, wherein the controller further includes a limiter that generates said control signal based on feedback values of the current i_{APF} and the current i_L flowing through the load, to control the current generator such that the current i_{APF} does not exceed the selected threshold value.

3. The active filter of claim 2, further comprising:

a first sensor that senses the current i_{APF} and provides a corresponding signal to the limiter that represents the feedback value for the current i_{APF}; and

a second sensor that senses the current i_L flowing through the load and provides a corresponding signal to the limiter that represents the feedback value for the current i_L.

4. The active filter of claim 2, wherein the limiter is configured to control the current generator such that even if the current i_{APF} necessary to compensate for the polluting harmonics on the power line exceeds said selected threshold value, the current i_{APF} generated by the current generator is limited to at most the selected threshold value.

5. The active filter of claim 2, wherein:

the power source comprises an input voltage source providing a voltage v_S; and

the limiter generates the control signal such that the current i_{APF} is controlled as:

$$i_{APF} = \begin{cases} i_L - v_S / R_{EM}\ ; & \left| i_L - v_S / R_{EM} \right| < I_{\max} \\ I_{\max}; & \left| i_L - v_S / R_{EM} \right| \geq I_{\max} \end{cases},$$

where R_{EM} represents the equivalent resistance seen by the input voltage source v_S, and $I_{\max}$ represents said selected threshold value.

6. The active filter of claim 5, further comprising a reference current generator that provides a reference current value to the controller, wherein the reference current value represents the ratio value V_S / R_{EM}.

7. The active filter of claim 6, wherein:

the current generator includes an energy storage device that sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed the selected threshold value; and

the reference current generator receives a voltage feedback value from the current generator that represents the energy storage device voltage, and the reference current generator determines the value R_{EM} based on the voltage feedback value from the current generator, to achieve energy balance whereby the energy storage device voltage does not exceed a selected limit.

8. The active filter of claim 1, wherein the current generator comprises:

an energy storage device; and

a switch controlled by the control signal from the controller, such that the energy storage device sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed a selected threshold value.

9. The active filer of claim 8, wherein:

the energy storage device includes a capacitor device; and

the current generator further includes an inductor, such that the capacitor devices sources or sinks the current i_{APF}, through the inductor.

10. An active filter connected to a power line between a power source and a load to compensate for polluting harmonics on the power line, the active filter comprising:

a current generator connected to the power line in a parallel circuit with the power source and the load, wherein in response to a control signal the current generator generates a current i_{APF} to compensate for polluting harmonics on the power line; and

a current controller that controls the current generator to compensate for the polluting harmonics on the power line, the controller including:

a first sensor that senses the current i_{APF} and provides a corresponding signal that represents a feedback value for the current i_{APF};

a second sensor that senses the current i_L flowing through the load and provides a corresponding signal that represents the feedback value for the current i_L; and

a limiter that generates said control signal based on feedback values of the current i_{APF} and the current i_L, wherein the limiter is configured to control the current generator such that if the current i_{APF} necessary to compensate for the polluting harmonics on the power line exceeds a selected threshold value, the current i_{APF} generated by the current generator is limited to at most the selected threshold value.

11. The active filter of claim 10, wherein:

the power source comprises an input voltage source providing a voltage v_S; and

the limiter generates the control signal such that the current i_{APF} is controlled as:

$$i_{APF} = \begin{cases} i_L - v_S/R_{EM}\ ; & |i_L - v_S/R_{EM}| < I_{\max} \\ I_{\max}; & |i_L - v_S/R_{EM}| \geq I_{\max} \end{cases},$$

where R_{EM} represents the equivalent resistance seen by the input voltage source v_S, and $I_{\max}$ represents said selected threshold value.

12. The active filter of claim 11, further comprising a reference current generator that provides a reference current value to the controller, wherein the reference current value represents the ratio value V_S/R_{EM}.

13. The active filter of claim 12, wherein:

the current generator includes an energy storage device that sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed the selected threshold value; and

the reference current generator receives a feedback value from the current generator that represents the level of the energy stored in the energy storage device, and the reference current generator determines the value R_{EM} based on the feedback value from the current generator, to achieve energy balance whereby the energy level of the energy storage device is maintained within predetermined limits.

14. The active filter of claim 13, wherein the current generator further comprises a switch controlled by the control signal from the controller, such that the energy storage device sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed a selected threshold value.

15. The active filer of claim 14, wherein:

the energy storage device includes a capacitor device; and

the current generator further includes an inductor, such that the capacitor devices sources or sinks the current i_{APF}, through the inductor.

16. A method of filtering a power line having a power source and a load connected thereto, comprising the steps of:

providing a current generator that can be connected to the power line, wherein the current generator generates a current i_{APF} to compensate for polluting harmonics on the power line; and

controlling the current generator to compensate for the polluting harmonics on the power line, such that the current i_{APF} does not exceed a selected threshold value.

17. The method of claim 16, wherein the steps of controlling the current generator further includes the steps of controlling the current generator based on feedback values of the current i_{APF} and the current i_L flowing through the load, such that the current i_{APF} does not exceed the selected threshold value.

18. The method of claim 17, wherein the steps of controlling the current generator further includes the step of:

sensing the APF current i_{APF} with a first sensor that provides a corresponding signal representing the feedback value for the current i_{APF}; and

sensing the load current i_L with a second sensor that provides a corresponding signal representing the feedback value for the current i_L.

19. The method of claim 17, wherein the steps of controlling the current generator further includes the step of:

controlling the current generator such that even if the current i_{APF} necessary to compensate for the polluting harmonics on the power line exceeds said selected threshold value, the current i_{APF} generated by the current generator is limited to at most the selected threshold value.

20. The method of claim 17, wherein:

the power source comprises an input voltage source providing a voltage v_S; and

the current i_{APF} is controlled such that:

$$i_{APF} = \begin{cases} i_L - v_S/R_{EM}\,; & |i_L - v_S/R_{EM}| < I_{\max} \\ I_{\max}\,; & |i_L - v_S/R_{EM}| \geq I_{\max} \end{cases},$$

where R_{EM} represents the equivalent resistance seen by the input voltage source v_S, and $I_{\max}$ represents said selected threshold value.

21. The method of claim 20, further comprising the steps of determining a reference current value that represents the ratio value V_S / R_{EM}.

22. The method of claim 21, wherein:

the current generator includes an energy storage device that sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed the selected threshold value; and

the steps of determining a reference current value, further includes the steps of receiving a voltage feedback value from the current generator that represents the energy storage device voltage, and determining the value R_{EM} based on the voltage feedback value from the current generator, to achieve energy balance whereby the energy storage device voltage does not exceed a selected limit.

23. The method of claim 16, wherein the current generator comprises:

an energy storage device; and

a controllable switch, such that the energy storage device sources or sinks the current i_{APF} as necessary to compensate for polluting harmonics on the power line, wherein the current i_{APF} does not exceed a selected threshold value.

24. The method of claim 23, wherein:

the energy storage device includes a capacitor device; and

the current generator further includes an inductor, such that the capacitor devices sources or sinks the current i_{APF}, through the inductor.

25. The method of claim 16, wherein the step of controlling the current generator further includes controlling the current generator to compensate for the polluting harmonics on the power line, such that the current i_{APF} is bounded by a selected upper threshold and a selected lower threshold.